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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/531,245	04/14/2005	John Joseph Senkevich	0094.074A	6502
23405	7590	09/27/2007		
HESLIN ROTHENBERG FARLEY & MESITI PC 5 COLUMBIA CIRCLE ALBANY, NY 12203				
			EXAMINER	
			MALEKZADEH, SEYED MASOUD	
			ART UNIT	PAPER NUMBER
			1722	
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			09/27/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/531,245	<b>Applicant(s)</b> SENKEVICH ET AL.	
	<b>Examiner</b> SEYED MALEKZADEH	<b>Art Unit</b> 1722	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 23 July 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1,2 and 4-17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2 and 4-17 is/are rejected.
- 7) ☒ Claim(s) 4-6 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

DETAILED ACTION

Response to Amendment

Claims 1-2 and 4-17 are pending.

In view of the amendment, filed on 07/23/2007 following rejections/objections are withdrawn from the previous office action for the reason of record.

- Rejection of claims 13, 14, 15, and 17 under 35 U.S.C. 112
- Rejection of claim 1-6 and 13-17 under 35 U.S.C. 102 (b) as being anticipated by Dela Rosa et al (US 6,527,855)
- Rejection of claims 7-8 and 12 under 35 U.S.C. 103 (a) as being unpatentable over DelaRosa et al ('855) in view of Hujanen et al (WO 02/45,167)
- Rejection of claims 9 and 11 under 35 U.S.C. 103 (a) as being unpatentable over DelaRosa et al ('855) and Hujanen et al ('167) and further in view of Pan et al (US 2003/0,054,149)
- Objection of claim 10 to as being dependent upon a rejected base claim.

*New Grounds of Rejection*

*Claim Objections*

Claims 4-6 are objected to under 37 CFR 1.75(c) as being in improper form because these claims are dependent to claim 3 which already has been cancelled by the applicants See MPEP § 608.01(n). Accordingly, the claims 4-6 have not been further treated on the merits.

*Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

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2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-2, 4-8 and 12-17 are rejected under 35 U.S.C.

103(a) as being unpatentable over DelaRosa et al (6,527,855) in view of Lopatin et al (US 6,482,656)

As to claims 1, 7, 12, and 16 DelaRosa et al ('855) discloses an atomic layer deposition (ALD) process comprised of depositing a layer from a metallorganic precursor on a noble or semi-noble metal substrate. The metal of the deposited layer may be Pd, Rh, Ru, Pt, Ir, Ag, Au, Ni, Co, Fe and the substrate is a metal nitride or a metal oxide substrate (See lines 1-8, column 2). DelaRosa et al ('855) further discloses that the temperatures typically used range from about 200° C to about 400° C. (See lines 51-52, column 3)

DelaRosa et al ('855) also teaches that the ALD process is performed by sequentially pulsing a precursor vapor or gas, and a reducing agent gas into a chamber (See lines 8-12, column 3) which include a metal nitride or a metal oxide substrate (See lines 1-8, column 2)

DelaRosa et al ('855) further discloses a substrate for the deposition may be any suitable substrate but in particular, may

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be tantalum, silicon, silicon dioxide or fluorinated silica glass. (See lines 19-25, column 4).

Furthermore, as to claims 13-15 and 17, DelaRosa et al ('855) discloses the metallorganic precursor is composed of the metal and one or more ligands, wherein the ligand may be any bidentate ligand. The examples of precursors include acetylacetonate (acac) compounds,  $\beta$ -diketonate compounds such as metal  $\beta$ -diketonate compounds, 4-pentafluoro (hfa or hfac) compounds which includes metal-hfac compounds such as  $\text{Pd}(\text{hfac})_2$ ,  $\text{Ru}(\text{hfac})_2$ ,  $\text{Rh}(\text{hfac})_2$ ,  $\text{Pt}(\text{hfac})_2$ ,  $\text{Ir}(\text{hfac})_2$ . (See lines 44-67, column 2).

DelaRosa et al ('855) further teaches that substrate surface was pretreated before deposition process by heating the substrate surface plate. (See lines 30-32, column 4).

However, DelaRosa et al ('855) fails to teach reducing gas is selected from glyoxylic acid and imidazole.

In the analogous art, Lopatin et al ('656) teach a method of forming a superconducting damascene interconnect structure. Method further include forming a cavity in an inter-level dielectric, and then forming a barrier layer in the cavity wherein the barrier layer is one or more of Ta, TaN, TaSiN, TiSiN, TiW, or WN. The barrier materials may also include cobalt

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(Co), nickel (Ni), palladium (Pd), molybdenum (Mo) and tungsten (W). (See lines 57-67, column 3 and lines 17-23, column 7).

Further, Lopatin et al ('656) teach atomic layer deposition (ALD) as a metal deposition technique for deposition of barrier layer (See lines 31-37, column 10) wherein a reducing agent selected from glyoxylic acid and imidazole is provided in the process. (See lines 20-25, column 12)

Therefore, It would have been obvious to one of ordinary skill in this art at the time of applicant's invention to modify atomic layer deposition process of DelaRosa et al ('855) by providing a reducing gas selected from glyoxylic acid and imidazole in the process chamber in order to improve the reducing process of metal ions to elemental state, and to eliminate impurities during ALD process, as suggested by Lopatin et al ('656).

Claims 9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over DelaRosa et al ('855) and Lopatin et al ('656) as applied to 1-8 and 12-17 of above, and further in view of Pan et al (US 2003/0054149).

DelaRosa et al ('855) and Lopatin et al ('656) disclose all the limitations of Atomic Layer Deposition (ALD) method as discussed above. However, DelaRosa et al ('855) and Lopatin et al ('656) do not teach about the use of an activated dielectric

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surface as a substrate wherein the activated dielectric comprises at least one of thiol, sulfide, tetra sulfide, phosphine, phosphide or amine groups as disclosed in claim 9, further do not teach that the dielectric surface is selected from CVD polymers, organic-inorganic hybrids, and silicon or metals having an oxide terminated surface as disclosed in claim 11.

In the analogous art, Pan ('149) discloses a process for the fabrication of a porous coating on top of an open-structure substrate (See Paragraph [001]). Pan ('149) further discloses the open structure substrate coated by a metals oxide or sulfide (See paragraph [0016] and [0017]). Pan ('149) further teaches depositing a layer of catalytic coating on the porous coating surface, which is a metal oxide or metal sulfide as a substrate surface by ALD process (See paragraph [0025]).

It would have been obvious to one of ordinary skill in this art at the time of applicant's invention to modify DelaRosa et al ('855) and Lopatin et al ('656) by providing a dielectric substrate surface such as sulfide and providing substrates having an oxide terminated surface as a dielectric substrate in order to minimize the electrical conductivity of the substrate surface used in ALD process because dielectric substrates have a high dielectric constants, as suggested by Pan et al ('149).



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Claims 9 and 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over DelaRosa et al ('855) and Lopatin et al ('656) as applied to 1-8 and 12-17 of above, and further in view of Senkevich et al. (US 2002/0182385).

DelaRosa et al ('855) and Lopatin et al ('656) disclose all the limitations of Atomic Layer Deposition (ALD) method as discussed above. However, DelaRosa et al ('855) and Lopatin et al ('656) do not teach the dielectric surface comprises one of thiol, sulfide, tetrasulfide, phosphine, phosphide or amine groups, as disclosed in claim 9 and dielectric surface comprises thiol groups, as suggested by Senkevich et al. ('385)

In the analogous art, Senkevich et al. ('385) teaches a method for metallizing a substrate by depositing a metallic thin film over the substrate surface by atomic layer deposition (ALD) process wherein the method includes providing a precursor for an element selected from the group consisting of sulfur, selenium, tellurium, phosphorus, antimony, iodine and bromine which is deposited directly on the surface of the substrate. Further, an atomic passivation layer comprising at least one of said elements, and then forming the layer directly on the atomic passivation layer. (See paragraph [0031]). Applicant attention is drawn to this point that according to Britannica Encyclopedia Mercaptan is also known as thiol (See Britannica Online

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Encyclopedia, <<http://www.britannica.com/eb/article-9072136>> for Thiol).

The substrate may be a dielectric material, or a diffusion barrier material, and may be composed of ceramic materials having an oxide surface, organic polymers, or organic/inorganic hybrid materials. (See paragraph [0031])

Senkevich et al. ('385) further teach a monolayer mercaptan SAM from a starting chemical material can form a one-monolayer thick film on dielectric or diffusion barrier material (See paragraph [0052]). Mercaptan is another name for thiol. (See paragraph [0059])

Further Senkevich et al. ('385) teach the monolayer mercaptan SAM grows rapidly to one monolayer and then will grow multilayer films, at times approximately 60 minutes. Further, mercaptan monolayer has a higher packing density. (See paragraph [0068])

Therefore, it would have been obvious for one of ordinary skill in the art at the time of applicants' invention to modify the method of DelaRosa et al ('855) and Lopatin et al ('656) by providing a dielectric surface comprises thiol group because the thiol layer grows rapidly to one monolayer and further thiol has a higher packing density. (See paragraph [0068]).

*Response to Arguments*

Applicant's arguments with respect to claims 1-2 and 4-17 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Masoud Malekzadeh whose telephone number is 571-272-6215. The examiner can normally be reached on Monday - Friday at 8:30 am - 5:00 pm.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra N. Gupta can be reached on (571) 272-1316. The fax number for the organization where this application or proceeding is assigned is 571-272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published application may

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be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

SMM



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